Geophysical Research Abstracts
Vol. 21, EGU2019-10034, 2019
EGU General Assembly 2019

Elevation Changes of the Greenland Ice Sheet from Sentinel-3A SAR Altimetry

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Since 1992, satellite-borne radar- and laser-altimetry have been used to record surface elevation change over the contemporary ice sheets. These observations have, in turn, provided estimates of volume change of the Greenland Ice Sheet (GrIS), from which mass fluctuations can be calculated with the use of climate models. Previously, conventional radar altimeters have performed poorly over high sloping terrain with heterogenous topography; however, the novel synthetic aperture radar interferometric (SARIn) mode of CryoSat-2, launched in 2010, has improved capability in these regions, principally over areas experiencing the largest changes around the ice-sheet margins and outlet regions. But CryoSat-2 employs its low resolution mode (LRM) over the ice-sheet interior, which fails to detect small-scale changes both spatially and temporally, such as seasonal and local accumulation and melt events.
Sentinel-3A, launched in February 2016, is the first satellite to use synthetic aperture radar (SAR) across the interior of the GrIS. This has improved the along-track resolution (sampling) to approximately 300 m, compared to CryoSat-2's LRM footprint which has a diameter approximately equal to 1.65 km. Although the ground track separation is smaller for CryoSat-2 due to its 369-day repeat cycle, Sentinel-3's 27-day repeat cycle provides high temporal resolution allowing for elevation changes to be calculated at monthly time intervals.
Here, we investigate the performance of the Sentinel-3A SAR altimetry mission across the GrIS. Using repeat-track and crossover analysis for observed elevation changes, we produce a monthly time series of the elevation change, describing seasonal (intra-annual) change over the interior of the ice-sheet (above the equilibrium line altitude) from June 2016 to December 2018. We also investigate the sensitivity of our results to different spatio-temporal statistical interpolation methods for the presented time-series and compare with CryoSat-2 LRM over the ice-sheet interior.